ENTEROHEMORRHAGIC *E. COLI* INCLUDING *E. COLI* O157:H7 INFECTION

Strains of Escherichia coli *that cause diarrhea are of six major categories: 1) enterohemorrhagic; 2) enterotoxigenic; 3) enteroinvasive; 4) enteropathogenic; 5) enteroaggregative; and 6) diffuse-adherent. Each category has a different pathogenesis, possesses distinct virulence properties, and comprises a separate set of O:H serotypes. Differing clinical syndromes and epidemiologic patterns may also be seen. Single cases of enterohemorrhagic* E. coli *are notifiable; clusters of other categories may be notifiable as water or foodborne outbreaks.*

DISEASE REPORTING

In Washington

DOH receives approximately 150 to 250 reports of enterohemorrhagic *E. coli* infections per year, for an average rate of 3.2/100,000 persons. On average, 1 death associated with *E. coli* infection is reported each year.

E. coli O157:H7 was first identified in Washington in 1986 during outbreaks in Seattle, Spokane, and Walla Walla. Sources implicated in *E. coli* O157:H7 outbreaks have included individuals (person to person spread), beef, lettuce, sprouts, raw milk, and swimming water.

Recent data suggests that the use of antibiotics to treat persons infected with *E. coli* O157:H7 may increase the risk of hemolytic uremic syndrome.

Purpose of reporting and surveillance

- To identify sources of transmission (e.g., a commercial product) and to prevent further transmission from such sources.
- When the source of infection appears to pose a risk of only a few individuals (e.g., an animal or a private meal), to inform those individuals how they can reduce their risk of exposure.
- To identify cases that may be a source of infection for others (e.g., a food handler) and prevent further transmission.
- To better characterize the epidemiology of this organism.

Reporting requirements

- Health care providers: **immediately notifiable to Local Health Jurisdiction**
- Hospitals: **immediately notifiable to Local Health Jurisdiction**
- Laboratories: notifiable to Local Health Jurisdiction within 2 workdays; specimen submission required

- Local health jurisdictions: notifiable to DOH Communicable Disease Epidemiology within 7 days of case investigation completion or summary information required within 21 days

CASE DEFINITION FOR SURVEILLANCE

Clinical criteria for diagnosis

An infection of variable severity characterized by diarrhea (often bloody) and abdominal cramps. Illness may be complicated by hemolytic uremic syndrome (HUS) or thrombotic thrombocytopenic purpura (TTP); asymptomatic infections also may occur.

Laboratory criteria for diagnosis

- Isolation of *Escherichia coli* O157:H7 from a specimen, or
- Isolation of Shiga toxin-producing *E. coli* from a clinical specimen.

Case definition

- Probable:
  - a case with isolation of E. coli O157 from a clinical specimen, pending confirmation of H7 or Shiga toxin production, or
  - a clinically compatible case that is epidemiologically linked to a confirmed or probable case, or
  - identification of Shiga toxin in a specimen from a clinically compatible case, or
  - definitive evidence of an elevated antibody titer to a known EHEC serotype from a clinically compatible case.

- Confirmed: a case that is laboratory confirmed.

A. DESCRIPTION

EHEC, Shiga toxin producing E. coli (STEC), E. coli O157:H7, Verotoxin producing E. coli (VTEC)

1. Identification

This category of diarrheogenic *E. coli* was recognized in 1982 when an outbreak of hemorrhagic colitis occurred in the US and was shown to be due to an unusual serotype, *E. coli* O157:H7, that had not previously been incriminated as an enteric pathogen. The diarrhea may range from mild and nonbloody to stools that are virtually all blood but contain no fecal leukocytes. The most feared clinical manifestations of EHEC infection are the hemolytic uremic syndrome (HUS) and thrombotic thrombocytopenic purpura (TTP). Approximately 2-7% of subjects who manifest EHEC diarrhea progress to develop HUS. EHEC elaborate potent cytotoxins called Shiga toxins 1 and 2. Shiga toxin 1 is identical to Shiga toxin elaborated by *Shigella dysenteriae* 1; notably, HUS is also a well recognized

severe complication of *S. dysenteriae* 1 disease. Previously, these toxins were called verotoxins 1 and 2 or Shiga-like toxins I and II. Elaboration of these toxins depends on the presence of certain phages carried by the bacteria. In addition, EHEC strains harbor a virulence plasmid that is involved in attachment of the bacteria to intestinal mucosa. Most EHEC strains have within their chromosome a pathogenicity island that contains multiple virulence genes encoding proteins that cause attaching and effacing lesions of the human intestinal mucosa.

In North America most strains of the most common EHEC serotype, O157:H7, can be identified in stool cultures by their inability to ferment sorbitol in media such as MacConkey-sorbitol (used to screen for *E. coli* O157:H7). Since it is now recognized that some EHEC strains ferment sorbitol, other techniques to detect EHEC must be employed. These include demonstrating the ability to elaborate Shiga toxins; serotyping to identify characteristics serotypes; or the use of DNA probes that identify the toxin genes, the presence of the EHEC virulence plasmid or specific sequences within the pathogenicity island. Lack of fever in most patients can help to differentiate this from shigellosis and dysentery caused by enteroinvasive strains of *E. coli* or by *Campylobacter*.

2. Infectious Agent

While the main EHEC serotype in North America is *E. coli* O157:H7, other serotypes such as O26:H11, O111:H8, O103:H2, O113:H21, and O104:H21 have been implicated.

3. Worldwide Occurrence

These infections are now recognized to be an important problem in North America, Europe, South Africa, Japan, the southern cone of South America and Australia. Their relative importance in the rest of the world is less well established. Serious outbreaks, including cases of hemorrhagic colitis, HUS, and some deaths, have occurred in the US from inadequately cooked hamburgers, unpasteurized milk, apple cider (made from apples that were probably contaminated by cow manure) and alfalfa sprouts.

4. Reservoir

Cattle are the most important reservoir of EHEC; humans may also serve as a reservoir for person to person transmission. There is increasing evidence that in North America deer may also serve as a reservoir.

5. Mode of Transmission

Transmission occurs mainly by ingestion of contaminated food; as with *Salmonella*, it is most often due to inadequately cooked beef (especially ground beef) and also raw milk and fruit or vegetables contaminated with ruminant feces. As with *Shigella*, transmission also occurs directly from person to person, in families, child care centers and custodial institutions. Waterborne transmission has also been documented; one outbreak was

associated with swimming in a crowded lake and one was caused by drinking contaminated unchlorinated municipal water.

6. Incubation period

Typically relatively long, ranging from 2 to 8 days, with a median of 3-4 days.

7. Period of communicability

The duration of excretion of the pathogen, which is typically for a week or less in adults but 3 weeks in one third of children. Prolonged carriage is uncommon.

8. Susceptibility and resistance

The infectious dose is very low. Little is known about differences in susceptibility and immunity. Old age appears to be a risk factor, so hypochlorhydria may be a factor contributing to susceptibility. Children less than 5 years of age are at greatest risk of developing HUS.

B. METHODS OF CONTROL

1. Preventive measures:

The potential severity of this disease calls for early involvement of the local health authorities to identify the source and apply appropriate specific preventive measures. As soon as the diagnosis is suspected, it is of paramount importance to block person to person transmission by instructing family members in the necessity for frequent (and especially postdefecatory) handwashing with soap and water, disposal of soiled diapers and human waste, and prevention of food and beverage contamination. Measures likely to reduce the incidence of illness include the following:

a. Manage slaughterhouse operations to minimize contamination of meat by animal intestinal contents.
b. Pasteurize milk and dairy products.
c. Irradiate beef, especially ground beef.
d. Heat beef adequately during cooking, especially ground beef. The USDA Food Safety Inspection Service and the 1997 FDA Food Code recommend cooking ground beef to an internal temperature of 155ºF (68ºC) for at least 15-16 seconds. Reliance on cooking until all pink color is gone is not as reliable as using a meat thermometer.
e. Protect, purify and chlorinate public water supplies; chlorinate swimming pools.
f. Ensure adequate hygiene in childcare centers, especially frequent handwashing with soap and water.

2. Control of patient, contacts and the immediate environment:

a. Report to local health authority: Case report of *E. coli* O157:H7 infection is obligatory in many states (US) and countries. Recognition and reporting of outbreaks is especially important.
b. Isolation: During acute illness, enteric precautions. Because of the extremely small infective dose, infected patients should not be employed to handle food or to provide child or patient care until 2 successive negative fecal samples or rectal swabs are obtained (collected 24 hours apart and not sooner than 48 hours after the last dose of antimicrobials).
c. Concurrent disinfection: Of feces and contaminated articles. In communities with a modern and adequate sewage disposal system, feces can be discharged directly into sewers without preliminary disinfection. Terminal cleaning.
d. Quarantine: None.
e. Management of contacts: When feasible, contacts with diarrhea should be excluded from food handling and the care of children or patients until the diarrhea ceases and 2 successive negative stool cultures are obtained. All contacts should be carefully indoctrinated in the need for thorough handwashing after defecation and before handling food or caring for children or patients.
f. Investigation of contacts and source of infection: Cultures of contacts should generally be confined to food handlers, attendants and children in child care centers and other situations where the spread of infection is particularly likely. Culture of suspected foods is relatively nonproductive in sporadic cases.
g. Specific treatment: Fluid and electrolyte replacement is important when diarrhea is watery or there are signs of dehydration (see CHOLERA, B2g). The role of antibacterial treatment of infections with *E. coli* O157:H7 and other EHEC is uncertain. Some evidence suggests that treatment with TMP-SMX fluorquinolones and certain other antimicrobials may precipitate complications such as HUS.

3. Epidemic measures

a. Report at once to the local health authority any group of acute bloody diarrhea cases, even in the absence of specific identification of the causal agent.
b. Search intensively for the specific vehicle (food or water) by which the infection was transmitted, evaluate potential for ongoing person to person transmission, and use the results of epidemiologic investigations to guide specific control measures.
c. Exclude use of and trace the source of suspected food; in large common-source foodborne outbreaks, prompt recall may prevent many cases.
d. If a waterborne outbreak is suspected, issue an order to boil water and chlorinate suspected water supplies adequately under competent supervision or do not use them.
e. If a swimming-associated outbreak is suspected, close pools or beaches until chlorinated or shown to be free of fecal contamination and until adequate toilet facilities are provided to prevent further contamination of water by bathers.
f. If a milkborne outbreak is suspected, pasteurize or boil the milk.
g. Prophylactic administration of antibiotics is not recommended.

h. Publicize the importance of handwashing after defecation; provide soap and individual paper towels if otherwise not available.

4. International measures

WHO Collaborating Centres.